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JOURNAL OF THE MECHANICS' INSTITUTE.

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From the Repertory of Patent Inventions.

SPECIFICATION OF THE PATENT GRANTED TO WILLIAM GILYARD SCARTH AND ROBERT SCARTH, OF LEEDS, IN THE COUNTY OF YORK, DYERS, FOR THE MANUFACTURING OR PREPARING OF A CERTAIN SUBSTANCE FOR BLUE DYERS FROM MATERIALS NOT HITHERTO USED FOR THAT PURPOSE, APPLICABLE FOR DYING BLUES AND OTHER COLORS.—Sealed February 26, 1836.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, we, the said William Gilyard Scarth and Robert Scarth, do hereby declare the nature of our invention, and the manner in which the same is to be performed, are fully described and ascertained in and by the following statement thereof (that is to say):

Our invention relates to that part of the process of dying wherein the substance called woad is used for dying blue and other colors, and our invention consists in the manufacture or preparation of that substance by the application of shumac peat, oak bark, and the stalks, stems, and other parts of the hop plant, in place of the plant heretofore cultivated and used for that purpose, and which is well known, and called woad.

Having thus explained the object of our invention, we will describe the manner of carrying the same into effect.

Take any quantity of the shumac of commerce, the same is to be springled with water and placed in a heap, in order to produce fermentation, in like manner to the course pursued with the preparation of the plant heretofore used, commencing with that part of its process at which it is set to ferment, and the result of such fermentation, when shumac is the material operated on, will be so similar to the like process of fermentation of the product of the plant heretofore employed, that a workman acquainted with the preparation of the substance called woad by dyers, as heretofore practised, will, when he is applying the material called shumac, readily judge of the maturity of the process, and when it is ready for the purposes of the dyer, whether for dying blue or other color. The great object of the workman is to see that the heap of shumac is equally fermented in all parts. The product thus obtained will then be suitable, and is to be used in the same manner as woad obtained from the material or plant heretofore used.

In using peat as a substitute for the product of the plant heretofore employed in the manufacture of the substance used by dyers called woad, peat will in some instances be found to be in such a condition as to be suitable at once to be used by the dyer, and this will readily be judged of by taking a sample and testing it; but should the peat not be found suitable for proceeding at once to the preparation of the woad vat, then the peat is to be pulverized, and submitted to the process of fermentation, by placing it in heaps and applying water, till it becomes of that state or condition to be suitable, and this will readily be judged of by a workman acquainted with the production of the substance as heretofore practised in obtaining it from the plant now in use.

In applying oak-bark, or the stalks, stems, and other parts of the hop plant in the manufacturing or producing the substance used by dyers called woad, such oak-bark, and the stems or stalks and other parts of the hop-plant, are, when dry, to be ground into a powder, and which is to be treated in a similar manner to the powder or balls prepared from the plant heretofore employed in order to produce fermentation; and the maturity of the process of fermentation is to be judged of in like manner as if the prepared material from the ordinary plant was being fermented, and having completed the process of fermentation, the material thus produced will then be

ready to be prepared or manufactured into the wood-vat in precisely the same manner as heretofore pursued when using the fermented product of the plant called woad, or the plant now cultivated for the purpose of making or preparing what is by dyers called woad.

Having thus described the nature of our invention, and the manner of carrying the same into effect, we would remark that what we claim as our invention is the manufacturing or preparing of the substance called woad for blue-dyers by the application of shumac, peat, oak-bark, and the stalks, stems, or other parts of the hop-plant, as a substitute for the plant called woad, that is, the plant now cultivated, which, being prepared by grinding and fermentation, is, when applied by dyers for dying blue and other colors, called woad, as above described.—In witness whereof, &c.

TRANSACTIONS OF THE INSTITUTION OF CIVIL ENGINEERS.

III. IMPROVED CANAL LOCK, BY JOSAUA FIELD, ESQ., F.R.S., V.P.INST.C.E.

The numerous and extensive navigable canals by which this kingdom is intersected, have tended in a great degree to exhaust every natural source from which water for their suppiy can be obtained; this renders the further extension of these important channels of commerce difficult, and in many cases impracticable. Some canals are altogether supplied by artificial means at an enormous expense, others only in part, whilst the greater number, depending upon natural sources alone, are more or less in want of water, and consequently the navigation is interrupted during the driest season of the year.

To lessen the great want of water by the common canal locks has long been a standing desideratum amongst engineers, and perhaps no subject has engaged more talent and ingenuity than the solution of this hydrostatic probiem. Numerous contrivances have been resorted to, some to save the whole and others part of the lockage water; many of these are beautiful in theory, and perfectly successful upon a small scale, but when they have been tried upon the full magnitude they have uniformly failed, chiefly from the circumstance of the scheme involving some prodigious moving plunger or caisson, floated or suspended; and in most cases this vessel has been required to be perfectly water or air tight, and poised with the utmost precision,—conditions hardly to be obtained in practice, and if attained, the expense alo e would defeat the object.

When the rough usage to which canal locks are subject is considered, and the ignorance of the persons necessarily employed in the management of them, it does not seem probable that any conservative lock will succeed until the whole apparatus shall be reduced to fixed masonry, and no other machinery employed than common gates and paddles, or sluices; for of all that have been invented, and for which upwards of twenty patents have been granted, none have been brought into practice for any length of time, except those of the side-pond class which save half the water, and which, though less simple than the common lock, consist of the same parts, and are found completely manageable by the persons usually employed on canals. Having been engaged in the execution of the largest conservative lock that has been constructed, my mind has been long engaged in the pursuit of some more simple means of effecting the same object, for very little reasoning on the subject will be sufficient to show that every common lock full of water, let down from the upper to the lower level, possesses in itself a physical power or force sufficient to raise an equal quantity of water from the lower level to the height from which it has descended,—action and reaction, cause and effect, being equal.

The method by which I propose to render the descending lock of water avai able for raising an equal quantity is, in its simplest form, as follows: at a suitable distance from any common lock, in any direction I have a side pond or basin, of an area and depth equal to the lock and communicating with it by a large and long culvert, rather under the lower level; the diameter and length of this culvert must be such that it will contain as much water as the lock, each end of the culvert is to be provided with a sluice, shown in the diagram, Fig. 1, at A and B. (Plate VI.)

The lock being full or equal to the upper level, and the side pond empty, or equal to the lower level, the operation will be as follows:—when the sluice or valve at A is opened, the head of water in the lock will very gradually put the water contained in

the culvert in motion, the velocity accelerating by the laws which govern the motion of fluids, until the levels of the water in the lock and side pond coincide; at this time the column of water in the culvert will have acquired a velocity due to the height fallen, it will then continue to move forward with a momentum that will not be destroyed, until the water has risen in the side pond to the height from which it descended in the lock, abating somewhat for the loss of effect from the friction of the water against the sides of the tunnel, &c., the water gradually coming to rest, when the sluice *B* in the side pond must be shut to retain it,—the converse operation is performed by opening the sluice *B*, when the lock will fill and the side pond become empty.

The principle of this lock may be well illustrated by the vibrations of a pendulum, which in like manner, actuated by the force of gravity, falls to the lowest point with an accelerating velocity, when it requires a momentum sufficient to raise it up the other side of the arc, nearly to the height from which it fell, the loss being only that arising from the friction of the suspending point and the resistance offered by the air.

It is from the close analogy it bears to the pendulum that I judge the culvert should contain as much weight of water as the lock that it may acquire sufficient momentum: it may contain more, but I think it should not contain less; thus the quantity of water raised will be equal to the quantity fallen, less the loss by friction in its transit;—the friction against the sides of a tube or culvert is simply as the diameter of the tube, while the area is as the square of the diameter, therefore the larger the tube the less in proportion will be the friction, hence the larger the lock the more complete will be the effect, and the operation of a model cannot be, like most other models of conservative locks, so perfect as a full-sized lock.

Although a lock upon this principle has not been executed upon the full scale, I have tried it in a model of sufficient magnitude to justify the greatest confidence of its perfect success.

The model consisted of two cisterns five feet long by twenty inches wide, having a communicating pipe of eight inches in diameter and forty-five feet long; a door valve, having a lever to open it, was fitted to each end of the pipe opening into the cisterns; a graduated scale was accurately placed in each cistern, and a ready means provided or adding to or taking from the water of eithe cistern as occasion might require—experiments were then made with various differences of levels, from twelve inches downwards, the results of which are here stated.

Difference of level 12 inches—the water rose in the opposite cistern		$10\frac{1}{2}$
8 inches	Do.	$7\frac{5}{8}$
6 "	Do.	$5\frac{7}{8}$
4 "	Do.	$3\frac{15}{16}$

When tried at less differences it apparently rose to the same height, and when both the doors or valves were left open, it continued vibrating nearly an hour before it came quite to rest; and it is remarkable that the vibrations, whether twelve inches or one-eight of an inch, were performed in equal times, namely 10 seconds. This experiment was tried in 1816, and I have annexed a sketch of the apparatus used for the purpose. Fig. 2.

Having described the principle in its simplest form, and given the results of the experiments made with the model, I shall now point out several modifications that have occurred to me in applying it to the purpose proposed.

The column of communication in the model and so far as spoken of hitherto, is straight; but this would remove the side pond to an inconvenient distance from the lock, and occupy much ground. This objection is removed by the plan proposed in Fig. 3, wherein the column forms a volute round the side pond or basin, by which means very little ground is required, and the sluices or paddles at each extremity of the culvert are brought very near together.

Fig. 4 shows its application to a double lock;—here the culvert is carried in a large circle, under the bed of the upper level,—one lock forming the side pond for the other.

The next and last modification I shall notice is described in Fig. 5. The object here is to dispense with the side pond altogether. As this is not so obvious as the former methods, it may be necessary to refer to the letters in the sketch. Let *A* be a long culvert, leading from the lock up into the upper level at *B*, having a sluice at each end, as before; there is a branch near *B* leading into *C*, which is an open cut from the lower level. Now when a lock full of water is to be discharged, the sluice at *D* is to be opened, the water will then run along *A*, and out at *C*, into the open cut; when half the water has

run out, a swinging valve, situated at *E*, must be moved so as to shut the passage into *C*, and open it into the upper level *B*; the water having acquired its greatest momentum,* will continue to run up into the upper level until the lock is empty, when *B* must be shut. The converse operation is thus performed:—open *B*, and the water will flow freely into the lock; when that is half full shut *B*, and the swinging valve *E* will open, and the column in motion will draw up water from the open cut, until the lock is full.—This modification, I admit, is open to many objections, and is one I should certainly not adopt;—the methods described in Figs. 3 and 4, are I conceive best adapted for practice.

The principle upon which this lock depends is the same as that of the hydraulic ram of Montgolfier, much used in France for raising water a considerable height, by a small fall. The experiments made by him, and those who have followed him, show that the loss by friction is not great, even in his pipes, which seldom exceed two inches in diameter; this, with the result of my expements with much larger pipes, leads me to expect the loss in a culvert of four or five feet diameter will be very inconsiderable. A calculation made also from the table given by Smeaton, of the head of water necessary to overcome the friction of pipes up to twelve inches' bore, at various altitudes, leads to the same result.

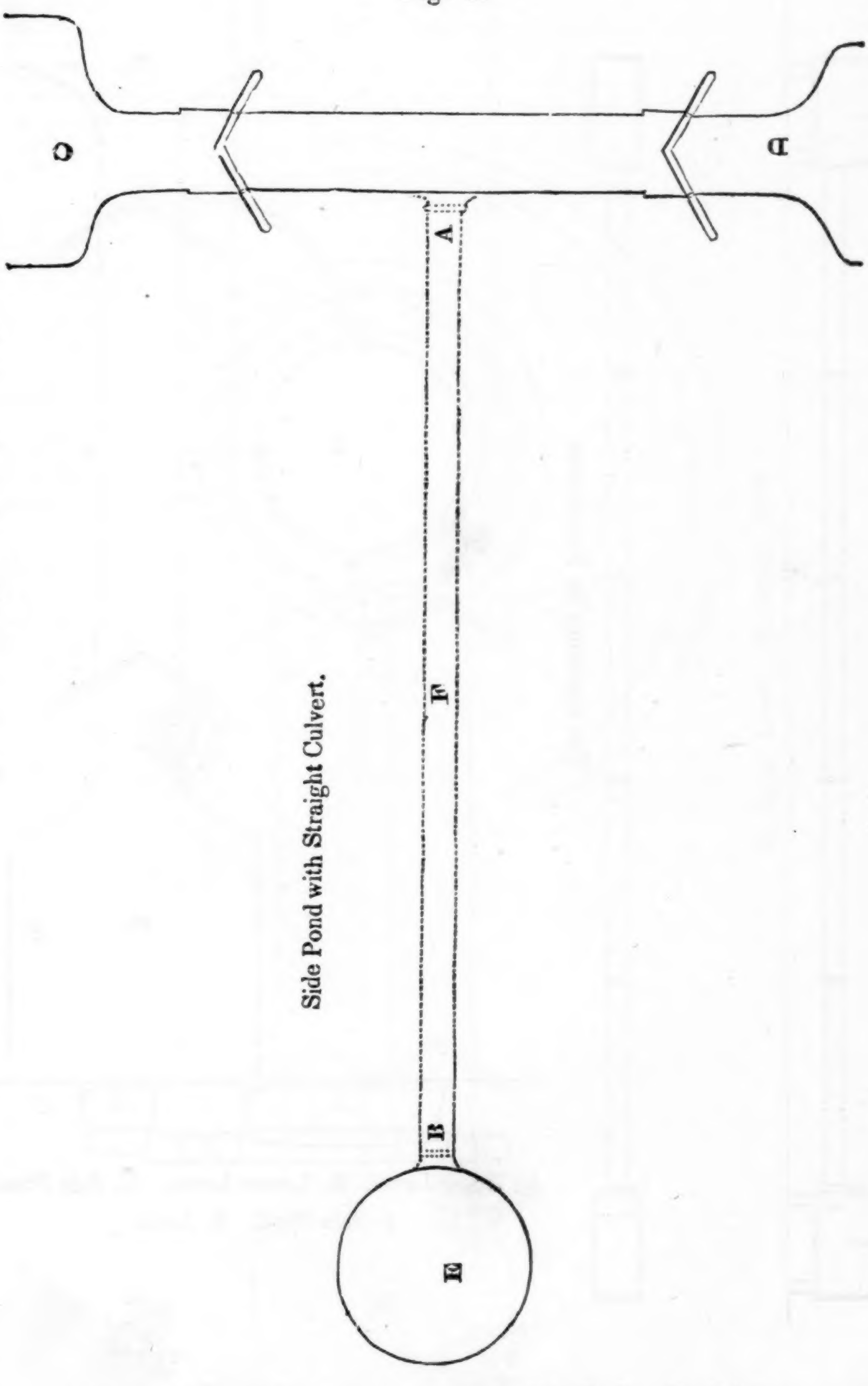
The time it would take to pass a barge, or to change the level of a lock upon this principle, would certainly not be longer than is required at present, and perhaps not so long.

I should imagine that a lock, well constructed upon this principle, having the culvert very smooth, would save nine-tenths of the water, and that the change would be effected in less than one minute. On an attentive consideration of this subject, several methods have occurred to me of making the large sluices, or paddles, so as to be quickly and easily opened and shut, and of various securities in the management of so large a column in motion, with some necessary compensations, &c., which would be obvious to any one about to adopt it.

I beg to present the foregoing remarks to the Institution of Civil Engineers, in the hope that the idea therein suggested being generally known may lead to the practical opperation of the plan.

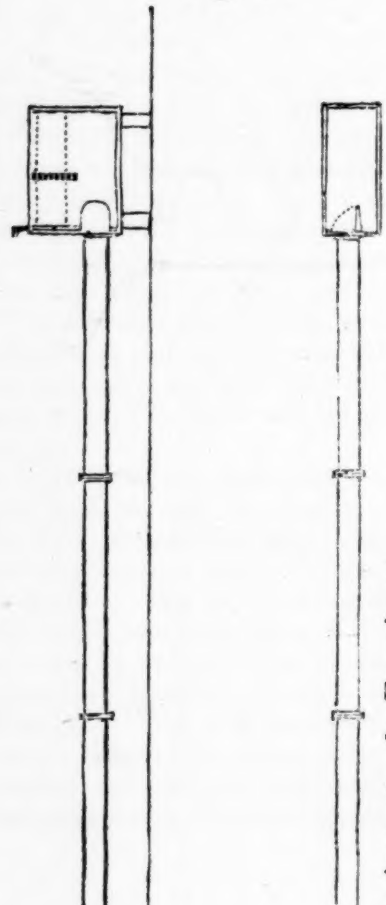
Plate 6.

Fig. 1.



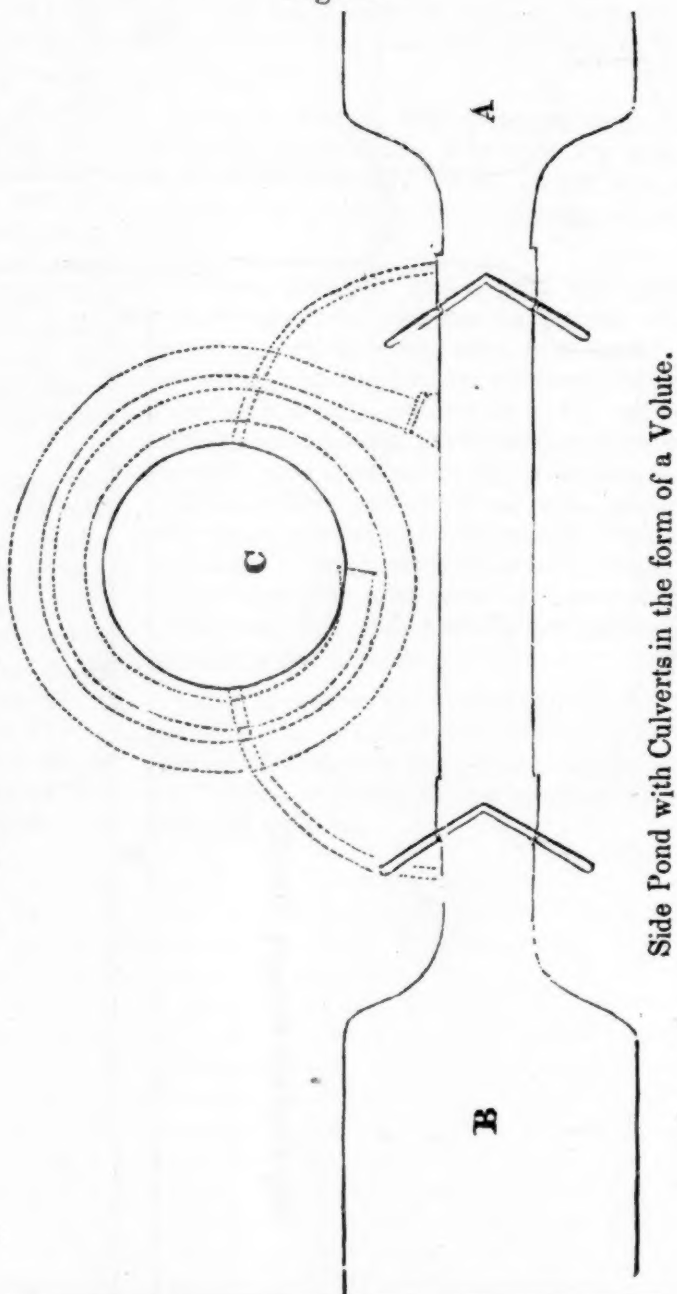
C, Upper Level. D, Lower Level. E, Side Pond. F, Culvert.

Fig. 2.



The Apparatus for Experiment.

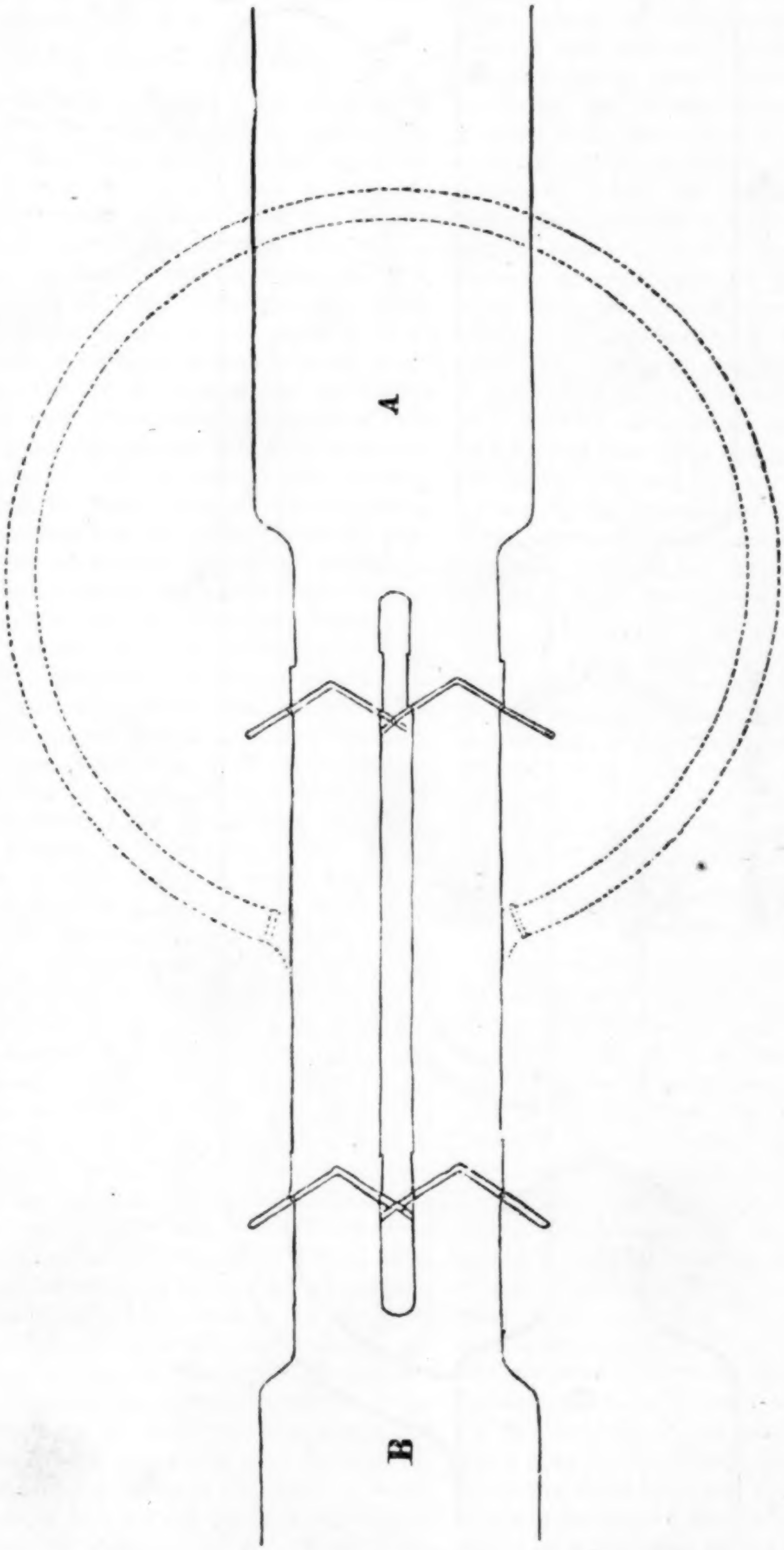
Fig. 3.



Side Pond with Culverts in the form of a Volute.

A, Upper Level. B, Lower Level. C, Side Pond.
1 Side Pond. 2, Lock.

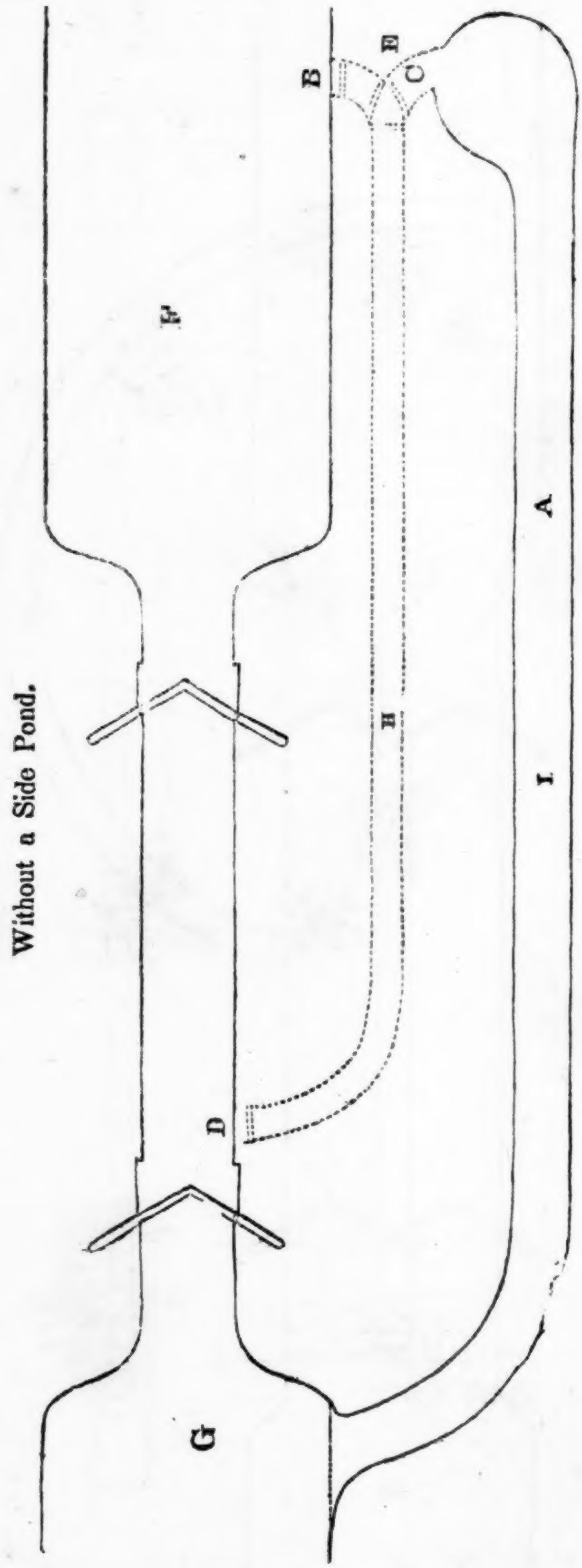
Fig. 4.



Double Locks with Circular Culvert under Upper Level.

A, Upper Level. B, Lower Level.

Fig. 5.



F, Upper Level. G, Lower Level. H, Long Culvert. I, Open Cut to the Lower Level.

ON THE LOCKS COMMONLY USED FOR RIVER AND CANAL NAVIGATION. BY MR. W. A. PROVIS, M. INST. C. E.

1st. Simple dam locks.

The earliest approximation to what is now known by the name of lock, consisted of a simple dam formed across the bed of a river, so as to raise the water to such a height as to allow vesse's to float along it. Where the river had a considerable fall with a strong current, it was necessary to have these dams at short distances from each other, otherwise the requisite depth of water could not be obtained. As the whole space between two of these dams was in fact the lock, it was necessary in passing from one level to another, to run down the water for the whole of that distance, thereby causing considerable delay, and a waste of water that would now be considered a serious evil. In China these dams are very common; they have also been used on the continent of Europe, and what is not a little extraordinary, are at this very day in use in our own country. My brother having given me a description of one of these which he saw on the river Ouse, near Tempsford, in Bedfordshire, I here insert it. The river is somewhat contracted in its breadth by a wall on each bank, between these two a third, or middle wall, is built, with cutwater ends. At the middle of each of the passages formed by these walls a sill is extended across the bottom of the channel, and pile planks are driven along its upper side, with the necessary sheeting to prevent the water getting under it. On one of the side walls a beam similar to the balance of a common canal lock gate is placed, which turning horizontally upon an axis, one end is made to abut against a projecting piece of timber which is fixed in the middle wall; this beam and the before mentioned sill form the top and bottom of a frame, on the upper side of which a row of vertical planks is placed, one at a time, so as to form the working dam; the other space has a piece of timber fixed at the top of its two side walls, corresponding with the sill below, and vertical planks are placed between these in the same manner as at the other opening, but as vessels are not intended to pass through more than one of the openings, the upper beam in the other is fixed. The use of this second space or opening is to allow the water to be run off more expeditiously, particularly during floods. In going up the stream, a vessel passes the place where the temporary dam is to be formed, and then the moveable or balance beam is swung round, the vertical planks put down, and the water thereby completely stopped till it rises to such a height as to run over the top of the dam; before this takes placel the vessel has sufficient water, and she proceeds on her voyage to the next dam above; these dams are kept open when there is no vessel near, and at all other times when there is sufficient water for navigation without penning it up. It may appear, at first, that it would be more advisable to have a complete gate similar to those now generally used on canal locks, but a gate would be attended with those inconveniences, that the water could not be run out in so short a time by its paddles as it can when the whole space which the gate would occupy is available, and also the difficulty of opening against a rapid stream a gate of the required size. Though this principle of damming up the water was a valuable improvement in our river navigation at the time it was introduced, yet as it is only applicable when water is abundant, and must at this time be considered a very rude mode of passing from one level to another, it requires no argument to show that it must soon give way to the adoption of our modern locks.

2d. Lock with a double set of gates, but no chamber walls.

The evils attendant on the dams just described were in a great measure removed by the introduction of double sets of gates or sluices; the upper set being constructed so near to the lower, as only to leave room enough for the vessel or vessels to float between them. Framed gates were also used instead of separate beams and planks, because the space to be emptied or filled was so small, that a very short time was required to pass the water; and there was no stream of sufficient strength to prevent their being easily opened. Where these locks are intended for rivers, it is usual to make a side cut or artificial canal for the purposes of the navigation, and to leave the river course for the passage of the surplus water. A quick bend of the river is generally chosen for one of these cuts, and to keep the water in the upper part of the river to a sufficient height for navigation, a dam or weir is made

across the old river course at or below the point where the artificial cut quits it. The lock is then built at the most convenient part of the cut, and its fall made equal to the difference in the levels of the water at the top and at the bottom of the dam or weir. When a vessel is going up the river, she floats along the cut, and passes between the lower gates into the lock, the lower gates are then closed, and the valves or paddles of the upper gates being opened, the water flows into the lock, and rises to the level of the upper part of the river; the upper gates are then opened, and the vessel floats out of the lock. Of course the reverse of this operation would conduct a vessel down the river.

It will be obvious to every one, that the sides of these locks must rise above the level of the higher part of the river, otherwise the water would flow over and injure them. The gates should also rise above the highest water's surface, or the water would flow over their tops and probably into the passing vessel, so as to endanger its safety or damage its cargo. It has been common to make the gates no higher than the water's surface, but the before mentioned inconveniences show the necessity of making them higher, and of constructing the dam or weir of sufficient breadth to take off with facility all the surplus water.

The abutments for the gates have been made of timber, brickwork and masonry, but when the double set of gates was first introduced, it was usual to leave the space between the upper and lower gates unprotected by either timber or any kind of building. Of course the agitation of the water in the lock was constantly washing away the earthen banks, thereby causing a risk of their being broken down by such continued weakening; and by enlarging the space between the two sets of gates, it occasioned a loss of time in emptying and filling, as well as a waste of water.

3d. *Locks with a double set of gates, and the sides of the chamber secured by timber.*

To check the mischievous tendency of leaving the chamber unprotected, the side banks of many old locks have been in part secured by driving a row of piles along the base of each slope, and fixing planks at the back of them, so as to form a wooden wall for about half the height of the lock; but there is sometimes a risk in trying this experiment, for the space between the two sets of gates being frequently lined or covered with puddle, resting on a porous substratum, the water often escapes by the sides of the piles, and causes not only leakage but a danger of blowing up the lock.—Examples of this sort of lock may be seen on the river Lea navigation.

4th. Common modern canal lock.

It is not until the construction of artificial canals became very general that locks were brought to any thing like perfection, for the difficulty of procuring sufficient supplies of water had been but partially felt when our inland navigation was confined to a few of the principal rivers.

When canals had spread themselves in various directions over the country, and water became so scarce and valuable as to be the cause of much litigation and expense, it was necessary to be careful of every resource, and to use it with the strictest economy. For this purpose, the space between the upper and lower gates was contracted to such a breadth as only to leave room enough for the vessel, and the bottom and sides were constructed of brickwork or masonry, instead of sloping banks of earth. By these means the superficial area of the lock was reduced to very little more than that of the vessel, and consequently was as small as it could be made.

The difference of altitude between the upper and lower levels, where the locks are constructed, varies according to local circumstances. Where the ground is longitudinally steep and water plentiful, the locks are generally made of greater lift or fall than where the ground is comparatively flat and water scarce. It is evident that, where the superficial area of locks is the same, one having a rise of 12 feet would require twice the quantity of water to fill it that would be requisite for one of 6 feet. Having many locks, however, of small lifts instead of a few of greater, increases the expense as well as the time for passing them.

For narrow canals these locks are generally made about 80 feet long, and 7½ to 8 feet wide in the chamber. On the Caledonian canal they are 180 feet long, 40 feet wide, and 30 feet deep. Locks are also constructed of every intermediate size.

Lock gates have till lately been made of

timber; but in consequence of the difficulty of procuring it of sufficient size for those on the Caledonian canal, cast iron was partially adopted for the heads, heels, and ribs. Iron gates, cast in one piece, have been used on the Ellesmere canal, as well as others with cast-iron framing and timber planking.

Whether constructed in a single leaf, or a pair of leaves, the gates of locks are usually made to turn horizontally upon a pivot at the bottom of the heel; but there is a singular exception at the locks on the Shrewsbury canal, where, at each end of the lock, a single gate is made to rise and fall vertically, in grooves in the side walls. A pulley is fixed on its axis about 12 feet above the lock, over this a chain is passed, one end of which is fixed to the top of the gate, and the other to a weight, by which the gate is so nearly balanced as to allow of its being worked up and down by one man. On entering or quitting the lock, the boats pass under these gates.

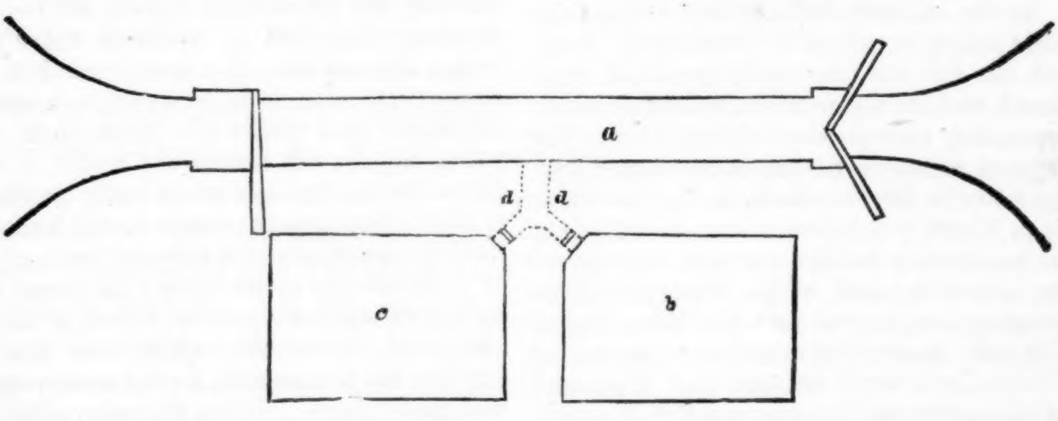
I am not aware of any lock in England of greater rise than 18 feet, but Tatham in his work on canals, (p. 164,) mentions one of 20 feet rise, built in 1643, by Dubie, between Ypres and Furnes, to connect the canals which bear those names. There are two pair of upper gates to this lock to guard against accidents.

On the Languedoc canal there is a celebrated circular lock, which has had more credit bestowed upon it than it deserves. The fact is, it is nothing more than a circular basin, into which three canals of different levels descend by common locks.

Various modifications of this principle have from time to time been adopted, either to save water, time, or expense.

5th. *Locks with side ponds.*

When water is scarce, it is common to construct side ponds, by which a considerable portion (in general one half) is saved. The usual number of these ponds is two, for it has been determined by experience, that when a greater number have been made use of, the loss occasioned by leakage and evaporation has sometimes been more than equal to the additional quantity of water retained.



In the accompanying sketch, *a* is a common lock, *b* and *c* two side ponds, (each equal to the area of the lock,) *d d* two culverts with paddles, each communicating with the lock and one of the side ponds. Supposing the lock to fall 8 feet, the bottom of the pond *b* will be 4 feet, and that of *c* 6 feet below the surface of the lock when full. If a vessel is to descend, it enters the lock when full, and the gates being closed, the paddles of the side pond *b* are opened, and the water flows into it till the level of the water in the lock is lowered, and that in the side pond raised, till they are the same, which will be when the water in the lock has sunk 2 feet; the paddles of the side pond *b* are then closed, and those of *c* opened; a similar operation then goes on till the water in the lock has sunk 2 feet more, when the paddles of *c* are also closed, and the remaining 4 feet of water in the lock is run into the lower level of the canal, through the paddles in the lock gates. When the lock is to be filled the water in *c* is first run into the lock, which raises its surface 2 feet, the water in *b* is next run into it, which raises the surface another 2 feet, making together half a lock full, the upper half is then run down from the higher level of the canal.

6th. Locks for the transit of vessels of different sizes.

Where vessels of different sizes have to pass the same locks, three pairs of gates are sometimes placed instead of two,—the distance between the upper and lower pairs being sufficient to admit the largest vessels, and that between the upper and middle pairs being adapted to the smaller class. By this contrivance, when a small vessel is to be passed through, the lowest pair of gates is not used, and when a large vessel goes through, the middle pair of gates is not worked. Thus, it is evident, that the quantity of water contained between the middle and lower pair of gates is saved when a small vessel passes, compared with what would be required were the middle set of gates omitted.

7th. Parallel double transit locks.

But where the transit is great, much time and water may be saved by a double transit lock, which is, two locks placed close to and parallel with each other, with a communication between them, which can be opened or cut off at pleasure by valves or paddles.

As one of these locks is kept full and the other empty, a vessel in descending floats into the full one, the upper gates are then closed, and the water is run, by means of the connecting culvert, into the empty lock, (the gates of which were previously closed,) till the water in the two locks is on the same level, which will be when each is half full; the connecting paddles are then closed, and the remaining half of the water in the descending lock is run into the lower canal. The next descending vessel has to be floated into the lock which remains half filled, and which consequently requires only half a lock of water to be run from the upper pond to raise it to the proper level, and then that half is transferred to the lock previously used, to serve the next descending vessel; but supposing a vessel to be ascending after the first descent, it will enter the empty lock, and receive a quarter lock of water from that which remained half filled: of course three-quarters of a lock of water is now required from the upper canal to complete the filling. If a descending vessel next follows, it enters the full lock, and its water is run into the lock which was previously left a quarter full, and when both have arrived at the same level, it is evident they will be each five-eighths full; and the succeeding descending vessel will require only three-eighths of a lock of water from the upper pond or canal. From these observations it will be seen that the double transit lock saves nearly one-half the water which a common single lock would require.

Sometimes the two parallel locks are made of different sizes, to suit the various description of vessels that may have to pass.

8th. Locks connected longitudinally, commonly called a chain of locks.

When loss of water is of no consequence, a considerable expense is sometimes saved, by placing the locks close together without any intermediate pond, for by passing from one immediately into the other, there is only required one pair of gates more than the number of locks so connected, besides a proportionate saving of masonry.—Thus, 8 connected locks would only require 9 pairs of gates, whilst, if they were detached, they would require 16 pairs; but to show that these cannot be adopted with propriety, excepting when water is abundant, it is necessary to observe that every two alternate ascending and descending vessels will require as many locks full of water as there are locks; for instance, if a vessel has just ascended, it has left all the locks full, a descending vessel then enters the upper lock, and when its gates are closed, the water is run down, but all the locks below being previously filled, they cannot contain it, and it consequently passes over the gates or weirs of all of them into the lower canal: the vessel has by this means descended to the level of the second lock, the water in which must also be run into the lower canal, for the same reason as already stated. When the water of all the locks has thus been run down, an ascending vessel will require all these locks to be filled from the upper canal, which, however, will be retained in the locks ready for the succeeding vessel to pass down. From this it will be evident that where 8 locks are connected, a descending vessel draws no water from the upper canal, because the locks are previously all filled, but it empties 8 locks of water into the lower canal; an ascending vessel on the contrary empties no water into the lower canal, because all the locks were previously emptied, but it draws 8 locks full from the upper canal in order to fill them; consequently the passing of one ascending

vessel, and one descending, requires 8 locks full of water.

9th. Other modes for passing vessels from one level to another.

By substituting machinery, either wholly or in part, have been adopted; but these have either failed entirely, or not been brought into general use.

MAGNETIC NEEDLE OF THE SURVEYOR'S COMPASS.

Though the principle of the directive power of the needle is well known, we believe that the following case may not be of rare occurrence, and state it for the benefit of the makers and users of instruments.

A Surveyor's Compass had been ordered which we procured and forwarded in complete order. It was returned, because when levelled by the bubbles, the needle was so much inclined as to touch the limb of the compass box

When we received the instrument, no such fault was found to exist, the needle was again found to be perfectly free and horizontal when the compass was leveled.

This is easily explained. For every degree that we approach the North pole, the *dip* of the needle is increased by one degree nearly. The latitude of the place in question was more than two degrees to the north of this city. On examining the limb and ascertaining the space occupied by 2° 20′, we were not surprised to find that this amount of deviation from horizontality, should cause the needle to touch.

The remedy was to place a counterpoise of brass or copper wire upon the needle, the adjustment being made here. On reaching the place of destination, the north pole will again be found to dip, and this is to be prevented by moving the counterpoise until the needle is exactly balanced.

These counterpoises in one shape or other were formerly quite common, but we have recently seen a vast number of instruments without any thing of the kind.—Such a Compass, though properly adjusted while in the shop, no sooner reaches a distance of 60 miles or more, to the North or South. than the respective pole will be found to have a tendency to dip by a very considerable and unpleasant amount.

We would recommend Instrument Makers to supply this counterpoise in all instances—for we are well convinced that they are often blamed for bad workmanship, when the very power that renders the needle useful is the true cause of the difficulty.

The dip not being constant in the same place, renders this adjustment still more necessary.

It need hardly be mentioned, that the construction of an extemporaneous counterpoise, can be accomplished by any one who uses an instrument.

From the Silk Culturist.

THE NATIVE, OR COMMON RED MULBERRY AS FOOD FOR SILK WORMS.

Lancaster, Ohio, Dec. 7th, 1836.

F. G. Comstock, Esq.

Sir:—Having learned from the "Culturist" and other authorities, that seven or eight pounds of cocoons are usually required to produce a pound of reeled silk, I can hardly hope to be credited when I state the result of an experiment or two that I lately made with a few cocoons of worms that were fed on leaves of the *morus rubra,** or common red mulberry of our western forests.

The cocoons were deprived of their loose floss, and the crysalids were perfectly dry. I weighed cocoons to the amount of 215 grains, and causing them to be reeled I obtained 75 grains of silk, equivalent, very nearly to 35 per cent. Observing that several grains were lost through unskilful management, the reeler being altogether inexperienced in the business, I determined to repeat the experiment, in order to ascertain, if possible, the maximum of silk that could be reeled from a given quantity of cocoons. I then carefully weighed just 100 grains of the cocoons, which yielded 39 grains of reeled silk, besides a few atoms of floss amounting perhaps to one grain.

It would thus appear that these cocoons contained about 40 per cent. of silk. What is the per centum of silk usually contained in dry cocoons? and what proportion of the silk contained by the cocoons is extracted in the ordinary process of reeling?

In determining the value of the red mulberry, as a source of food for the silk worm, we should inquire—

1st. What is the quality of the silk it produces?

2nd. Is the red American mulberry, a tree of as rapid growth as the white Italian, with which we would naturally compare it?

3rdly. Does the former produce as abundant a foliage as the latter?

4th. Is the foliage of the American tree as nutritious as that of the Italian—and do worms fed upon the former produce as good cocoons as those fed upon the latter?

1. With regard to the quality of the silk obtained in my experiments, I do not profess to be a competent judge; but I certainly cannot conceive that any thing of the silk kind could excel it in fineness and brilliancy. My judgment, however, is not needed to establish the character of the silk produced from the American mulberry.—We are already in possession of an overwhelming mass of evidence tending to prove most decisively, that this silk will bear comparison with the *best* that can be produced from any other source. Your readers may find some of this evidence in articles on the 92d, 94th, 96th, 105th, 109th, 138th, 155th and 156th pages of the "Silk Culturist," and also in a document published by Congress in 1828, and containing "information in relation to the growth and manufacture of silk."

In addition to these testimonials, I would present the evidence of Mr. D'Homergue, a French silk manufacturer, who pronounced a sample of reeled silk which had been produced from the red mulberry to be "indeed beautiful"—"not surpassed by any that he had ever seen," and "equal in firmness to any other."

I could also demonstrate by citing several authorities, that sewing silk produced from our native mulberry is *stronger* than the European article.

2. With regard to the second query I would premise that it is hardly fair to compare a plant in a state of nature with one that has enjoyed the advantages of cultivation. Notwithstanding, however, the disadvantage that exists on the side of the American mulberry, it has the appearance of being the more thrifty tree, if I might be permitted to judge from a few specimens that I have seen of the Italian tree.

3. If there is any difference in regard to the quantity of foliage yielded by each, I believe that the difference is in favor of the American tree. At least it is certain that the red mulberry has the important advantage of producing a much larger leaf than the other.

4. That the leaves of the American mulberry are as nutritious as those of the Italian, and that a given quantity of the former will produce as much silk as the same quantity of the latter, there can be no doubt. And all observers concur in remarking that the cocoons produced from each are equally fine. Mr. Jesse Waltz of this place informed me that he and his neighbor, Gen. P. Beecher, each fed a few silk worms in the same season, Mr. Waltz using the common wild mulberry, while Gen. Beecher used the Italian; and that upon comparing the cocoons, there was not the least perceptible difference. The cocoons were reeled, and upon a second comparison no difference in the quality of the silk could be discovered.

I would now inquire, why in the name of common sense, persons in the west who wish to engage in the silk culture should wait on the tardy growth of the Italian mulberry from the seed, when the forests every where around them abound with a tree altogether equal, if not superior to it. In almost every neighborhood a considerable cocoonery might be profitably supplied from trees planted by the hand of nature. But as these trees are generally somewhat dispersed, and as the climbing of large trees is inconvenient, I would recommend the plan of propagating the red mulberry by means of cuttings set hedgewise. By stocking the requisite quantity of ground with thrifty cuttings, a person might, on the second year, have any amount of foliage that he might desire.

One of your correspondents estimates that an acre of ground set with cuttings of the Chinese mulberry will on the first year yield 10,000 pounds of leaves. It is al-

lowed by some writers that 100 pounds of foliage will produce one pound of silk. If this supposition is correct, then the produce of one acre on the first year would be 100 pounds of silk, worth, when reeled, $500. I feel confident that on the second year a result equal to this might be obtained from our native mulberry. I am not sure that the foliage might not be profitably used even on the first year.

Permit me to suggest a theory in regard to the Chinese mulberry. I am persuaded that it is a creature of cultivation. It is propagated altogether by layers and cuttings, instead of seed; and the stems are cut down every year to the ground in order to obtain an annual crop of fresh shoots.—It is to these circumstances of its propagation and culture that the luxuriance of its growth, and the largeness and tenderness of its leaves, are owing. Hence will appear the reason why a similar plant is not obtained when attempts are made to propagate it from the seed. The plant obtained from the seed is a *natural* production; while that produced by other means is an artificial one. I believe that I can originate a new kind of *morus multicaulis* quite as good as the old, from the red mulberry. I design to make the experiment next summer. For a commencement, I can obtain from trees from which some of the larger branches had been accidentally broken off, a considerable number of shoots five and a half feet in length, the growth of last summer—and I can also get a few sprouts of a similar growth and age with the roots attached.

Yours respectfully,
JOHN WILLIAMS.

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* This is the true botanical appellation. Some have improperly called it *Morus nigra*, or black mulberry. The black mulberry is not a native of North America.

CULTIVATION OF THE PRAIRIES.—The following letters from, and to, the Hon. H. L. Ellsworth, superintendant of the Patent Office at Washington city, give a better idea of the cost of cultivating the Western Prairies than we have before seen, and we think our readers generally will be pleased with a perusal of them.

WASHINGTON, Jan. 1, 1837.

Dear Sir—You doubtless expect some further statement than has been received respecting the investment made for you in the valley of the Wabash. A desire to meet my son, who was daily expected from Lafayette, has delayed my writing until this time. And now, let me say, generally, that the west has grown, and will continue to increase beyond the most sanguine calculations. Nor will any action of general government materially check the advancement of the lands which are judiciously located on the great western canals or railroads. Very little is yet known of the valley of the Wabash. Although the fertility of the soil is unequalled, still few have ever seen this country. The reason is obvious, there is no communication with it, and hence speculators and settlers have passed around it going west, either by the Michigan Lake, or by the Ohio and Mississippi rivers.

Five thousand persons left Buffalo in one day to go up the lake, and yet not one went into the valley of the Wabash. A slight inspection of the maps of Indiana, Ohio, and Illinois, will show a direct route to the Mississippi from the west end of Lake Erie, to be up the Maumee and down the Wabash valley to Lafayette. It may, therefore, be considered certain that when the railroad from St. Louis to Lafayette is completed, the great travel from the Mississippi valley to the east, will be by the lakes through the Wabash and Erie Canal the shortest and quickest route by several days. A person at the mouth of the Ohio will pass up to St. Louis, then take the railroad and canal to Lake Erie, in preference to following the meanders of the Ohio river in a steamboat. Can there be a doubt on this subject? What time will be occupied on this route to New-York? Not exceeding six days. From St. Louis to Lafayette, (240 miles,) one day may be allowed; from Lafayette to the lake, at the rate of $4\frac{1}{2}$ to 5 miles per hour on the canal, (now in operation considerable part of the way,) forty-eight hours; on the lake, 24 hours; and from the lake to New-York city, via railroad, (now commenced,) not exceeding two days.

What changes this must make in the value of property on the route! The value of land depends on the fertility of the soil and the facility of transportation. From a personal inspection of the western States, during six years past, I am fully convinced the Wabash valley has the best soil and most favorable climate. In the latitude of Philadelphia, you avoid the extreme of great heat in summer and of cold in winter, and also avoid the danger of early frosts, so prevalent in a higher latitude. You may ask, what will be the markets for Indiana? I answer, New-York and New-Orleans.—The former by the Erie Canal, and the latter by the Wabash river, (navigable to Lafayette for steamboats,) and by the railroad above named to St. Louis, also Montreal by the Welland Canal. A choice of all these markets, equally accessible, is presented to farmers on the Wabash valley; and one peculiar advantage this valley possesses over Michigan and Wisconsin, is the early navigation of the Wabash river. The produce of this valley can by this river pass down to New-Orleans in flat boats, free of tolls, and be transported to Charleston, Baltimore, New-York, and Boston, six weeks before the New-York canal opens. This early market may be estimated at a good profit in business.

You may ask, if the Wabash and Erie Canals will surely be completed? Undoubtedly they will. Indiana and Ohio are pledged to complete them. Nearly all is now under contract, and government has given lands adjoining sufficient to finish the same, *without any expense to the States.*

As like causes (other things being equal) produce like effects, it will not tax your credulity to believe, that the rich lands of the Wabash valley will equal those on the Ohio, New-York, and Pennsylvania canals which vary from $25 to $60 per acre. Is it possible that lands, yielding forty bushels of wheat, seventy bushels of corn, sixty bushels of oats, and four hundred and fifty bushels of potatoes, and distant only ten to twelve days transportation from New-York or New-Orleans cities, can be less than $30 per acre?

In making selections, I have, when practicable, procured both prairie and timber, though I am sure there has been a common error to pass the rich prairie because timber cannot be found adjoining, at government price. Under this belief many settlers have, to their sorrow, entered the timber and left the prairie, because they suppose nobody would enter that without possessing the timber. This prairie has been lately entered. And such is the facility of raising timber on prairies by sowing the seed of black walnut and locust, that the desire for timber land has diminished.—Those who doubt the comparative value of prairie and timber land., will do well to consider that $12 is a fair price for clearing timber land. Timber land when cleared in the usual manner, is left incumbered with stumps and roots, fatal obstacles to labor-saving machines. $12,000 will be required to clear 1,000 acres of timber land; whereas the 1,000 acres of prairie can be put into tame grass, without ploughing.

A prairie farm may be put in complete cultivation, at from $3 75 to $9 per acre, according to the annexed computations from my son Edward, who has been extensively engaged in cultivating the prairie for the last year. The annexed letter from Mr. Newell will also give much valuable information on this point. From a personal examination of the lands in France and on the Wabash valley, I feel no hesitation in pronouncing the latter decidedly the best for the beet sugar manufacture.—In France, eight, ten, and twelve dollars per acre are paid for rent, and yet great profits are made. An acre of good land will yield 44,000 pounds of sugar beet, from which 2,400 pounds of sugar can be extracted, which at ten cents per pound, amounts to $240 per acre.

To be continued.
